

P R O J E C T facts

DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY

OIL recovery
P R O G R A M

CYCLIC CO₂ STIMULATION TO IMPROVE CO₂ FLOODING — OXY'S FIELD PROJECT

Project Description

In this project, Oxy USA, Inc., is demonstrating the advantages of applying advanced reservoir management techniques, hydraulic fracturing and cyclic CO₂ stimulation to improve the economics and efficiencies of CO₂ floods in previously waterflooded carbonate reservoirs in the Permian Basin of West Texas. Working in the South Welch Unit, Oxy used advanced three-dimensional seismic imaging and log and core analysis to obtain a thorough description of the San Andres Formation reservoir to assist in the design of the most effective recovery processes. Fractures were created by injecting pressurized fluids into the reservoir strata to provide gas injection efficiency. The length and orientation of the fractures were determined to design the most efficient reservoir fluid flow patterns.

Cyclic (huff-n-puff) CO₂ stimulation was begun by injecting CO₂ into the well, then temporarily shutting in the well for up to four weeks. The CO₂ reacts with the oil, reducing its viscosity. The oil is then easier to move, and can be more efficiently "swept" to a producing well by water pumped into the reservoir from an adjacent injection well. Computer simulation and monitoring the fluid flow reactions help to optimize the location of other injection wells to be used in the field-wide flood. These stimulation treatments are intended to increase oil production more quickly, generating revenue to help pay back the large front-end investment.

As of December 1995, five wells have undergone cyclic CO₂ stimulation treatment: one well has shown results that would enhance economics of a CO₂ flood; one well has shown increased production; two wells showed increased oil rates, but did not make up for the lost production from the shut in and soak period; and one well showed no response. Oxy is currently refining its understanding of the reservoir by incorporating rock and fluid analysis with the 3-D seismic interpretations, and will use this improved geologic description to evaluate the results of the well treatments.

Program Goal

The Department of Energy's Oil Program incorporated DOE and industry input to determine technologies that could effectively overcome barriers to production and prolong the productive life of the nation's domestic oil fields. Cyclic CO₂ injection is one of those that industry recommended for the carbonate reservoirs of the Permian Basin.

Successful demonstration that the CO₂ huff-n-puff process can be operated economically in the Permian Basin and in other areas where larger, more expensive types of CO₂ flooding would not be used will provide operators with the incentive to implement the process. An estimated 2 billion barrels could be recovered from the Permian Basin San Andres reservoirs, and as much as 5.5 billion barrels throughout the U.S., using this technology.

PRIMARY PROJECT

PARTNER

Oxy USA, Inc
Midland, TX

FOSSIL ENERGY PROGRAM

**Oil Recovery Field
Demonstration**

MAIN SITE

Welch Field
Dawson Co., TX

TOTAL ESTIMATED COST

\$22.2 million

COST SHARING

DOE - \$11.1 million
Non-DOE - \$11.1 million

DE - FC22 - 93BC14990

Project Partners

OXY USA, INC.
Midland, TX

HALLIBURTON SERVICES
Midland, TX

ADVANCED RESERVOIR TECHNOLOGIES
Dallas, TX

T. SCOTT HICKMAN & ASSOCIATES
Midland, TX

RESERVOIR SIMULATION RESOURCE CORP.
Tulsa, OK

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Project Benefits

The Permian Basin of West Texas and Southeast New Mexico represents approximately one-third of the U.S. oil reserve potential from shallow shelf carbonate reservoirs. Many of the fields have been producing from these reservoirs for over 40 years, and the remaining oil is becoming more difficult to produce with current technologies.

CO₂ flooding has the technological capability to recover remaining reserves, but the high cost of obtaining CO₂ supplies and installing CO₂ flood facilities prevents operators from applying the technology in lower-quality carbonate reservoirs. The projects cannot be justified economically, given the relatively long time between installation of CO₂ flood facilities and significant increases in production.

Oxy's demonstration of applying advanced reservoir imaging and analysis, rock fracturing and cyclic CO₂ stimulation combined with computer simulation and monitoring techniques is designed to show that this multidisciplinary approach can improve the economics and efficiency of CO₂ flood projects in the Welch Field. The field was discovered in 1936; waterflooding began in 1958 and was expanded to full field in 1972. The Welch Field has produced over 63 million barrels of oil from the San Andres Formation, 21.5% of the original oil in place. Oxy's goal is to recover an additional 1.7 million barrels of oil from the South Welch Unit, and demonstrate that using these technologies can make CO₂ flooding economically attractive at the West Welch Unit, where the process was previously considered infeasible.

Successful demonstration of these technologies will have a rapid impact in both the Permian Basin, because of the abundance of CO₂ sources and services, and in other carbonate reservoirs where capital-intensive CO₂ flood projects would otherwise not be used. Additional reserves producible by cyclic CO₂ stimulation in the Permian Basin San Andres reservoirs are estimated at 2 billion barrels of oil—5.7 million barrels in the West Welch Unit alone, and the total U.S. domestic production potential could be as much as 5.5 billion barrels.

Cost Profile (Dollars in Millions)

	Budget Period 1		Budget Period 2	
	08/03/94	02/28/96	09/30/96	09/30/00
Department of Energy*	\$2.0		\$9.1	
Private Sector Partners	\$2.0		\$9.1	

* Obligated Funding

Key Milestones

